Course Outline

MATS1101

Engineering Materials and Chemistry

Materials Science and Engineering

Science

T3, 2022

1. Staff

Position	Name	Email	Consultation times and locations	Contact Details
Course Convenor and Lecturer (Materials)	Dr Caitlin Healy	caitlin.healy@unsw.edu.au	Room 401, Hilmer Building (E10), by appointment	Phone: 9065 0450
Lecturer (Chemistry)	Professor Timothy Schmidt	dongjun.kim@unsw.edu.au	Room 634, Science & Engineering Building (E8), byappointment	Phone: 9385 4568
Chemistry Laboratory Administrator (Chemistry)	Dr Ron Haines	r.haines@unsw.edu.au	Room 128, Dalton Building, by appointment.	Phone: 9385 4666
Chemistry Tutorial Administrator	Ms Trinah De Leon	firstyearchem@unsw.edu.au	Room 312 Robert Webster Building	Phone: 9385 4651

2. Course information

Units of credit: 6

Pre-requisite(s): None

Timetabling website: https://timetable.unsw.edu.au/2022/MATS1101.html

Teaching times and locations:

	Lecture	Tutorial	Lecture	Lecture	Lecture
Day	Monday	Monday	Thursday	Friday	Friday
Stream	Materials	Materials	Chemistry	Materials	Chemistry
Location	Rex Vowels Theatre	Rex Vowels Theatre	Ainsworth G03	Rex Vowels Theatre	Ainsworth G03
Time	12-1 pm	1-2 pm	1-2 pm	2-3 pm	5-6 pm
Weeks	1-3,5, 7-10	2-3, 5, 7-10	1-5, 7-10	1-5, 7-10	1, 3, 5, 7 & 9

Students will enrol in chemistry/materials laboratories and the chemistry tutorials individually check your myUNSW account.

2.1 Course summary

Materials Strand: Structure-property relationships of the main types of engineering materials (metals, ceramics, polymers and composites). Micromechanisms of elastic and plastic deformation. Fracture mechanisms for ductile, brittle, creep and fatigue modes of failure; corrosion. Phase equilibria of alloys; microstructural control by thermomechanical processing and application to commercial engineering materials. Laboratory and tutorial work include experiments on mechanical testing, cast and recrystallised structures, ferrous and non-ferrous microstructures, and fracture and failure analysis.

Chemistry strand: Chemistry in engineering; understanding the properties of materials at an atomic and molecular level; relating macroscopic engineering properties to the underlying structure of the material. (in the following, 'S' refers to the text Silberberg 'Chemistry – The Molecular Nature of Matter and Change', 4th Edn).

- Introduction (S Ch. 2, 3, 4): Elementary atomic structure, isotopes, nomenclature; the mole concept, atomic and molar mass; stoichiometry, formulae, equations; chemical reaction types, precipitation, acid-base, and redox reaction; oxidation numbers, oxidation state; molarity, limiting reactants, and product yields.
- Structure and Bonding (S Ch. 8, 9): Electronic configuration; metallic, ionic and covalent bonding; electronegativity, bond polarity, and bond strength; molecular shape and Lewis structure.
- States of Matter (S Ch. 9, 12): Solids, liquids and gases; intermolecular forces; properties of liquids, melting and boiling points; solvent properties and solubility; metallic, ionic, covalentnetworks and molecular solids; chemical aspects of ceramics and glasses; chemical vapour deposition.
- Chemical Equilibrium in Aqueous Solution (S Ch. 17, 18, 19): The equilibrium state, equilibrium constants, Le Chatelier's principle, quantitative calculations; acid-base equilibria, pH, buffers.
- Organic Chemistry and Polymers (S Ch. 15): The systematic chemistry of carbon compounds; nomenclature and properties of common organic functional groups; isomer and stereochemistry; organic reactions, oxidation, reduction, addition, substitution, and elimination; fundamentals of polymer chemistry.

2.2 Course aims

Materials Strand: To provide an understanding of engineering materials in terms of the factors which dictate their behaviour.

Chemistry strand: To introduce the chemistry necessary to understand the structure and properties of engineering materials.

2.3 Course learning outcomes (CLO)

At the successful completion of this course you (the student) should be able to:

1. Describe relationships between materials structures, properties and processes through classes and laboratory activities
2. Make informed decisions in materials selection for engineering design
3. Connect chemical concepts to real-world applications through a firm foundation in the fundamentals of chemistry for materials science
4. Demonstrate an ability to work safely in a chemistry laboratory, to perform quantitative and qualitative chemical analyses, and to correctly use the language of chemistry to describe and interpret observations

2.4 Relationship between course and program learning outcomes and assessments

Course Learning Outcome (CLO)	LO Statement	Program Learning Outcome (PLO)	Related Tasks & Assessment
CLO 1	Describe…	1 & 2	Mid-term exam, Materials laboratories & Final exam
CLO 2	Make…	1 & 2	Mid-term exam & Final exam
CLO 3	Connect…	1	Mid-term exam, Chemistry laboratories & Final exam
CLO 4	Demonstrate…	5 & 6	Materials laboratories & Chemistry laboratories

3. Strategies and approaches to learning

3.1 Learning and teaching activities

(based on UNSW Learning Guidelines)

- *Students are actively engaged in the learning process.*

It is expected that, in addition to attending classes, students will read, write, discuss, and engage in analysing the course content.

- *Effective learning is supported by a climate of inquiry where students feel appropriately challenged.*

Students are expected to be challenged by the course content and to challenge their own preconceptions, knowledge, and understanding by questioning information, concepts, and approaches during class and study.

- *Learning is more effective when students' prior experience and knowledge are recognised and built on.*

Coursework, tutorials, assignments, laboratories, examinations, and other forms of learning and assessment are intended to provide students with the opportunity to cross-reference these activities in a meaningful way with their own experience and knowledge.

- *Students become more engaged in the learning process if they can see the relevance of their studies to professional and disciplinary contexts*

The course content is designed to incorporate both theoretical and practical concepts, where the latter is intended to be applicable to real-world situations and contexts.

Lectures: The core concepts will be taught in lectures, students will have access to the lectures notes before class for annotation during the lecture. Students will be engaged in the learning process through class discussions and problem-solving questions independently and working together with partners and groups.

Labs: Experimental techniques and procedures will be taught through laboratories classes and laboratory reports following the class. Students will actively complete the experiments gaining

experience of important materials testing and characterisation techniques. Students will be able to reflect on the experiments and learn to process data through the lab reports after class.

3.2 Expectations of students

- Students must attend at least 80% of all classes with the expectation that students only miss classes due to illness or unforeseen circumstances
- Students must read through lecture notes and lab sheets prior to class
- During class, students are expected to engage actively in class discussions
- Students should work through lecture, tutorial and textbook questions
- Students should read through the relevant chapters of the prescribed textbook.
- Students should complete all assessment tasks and submit them on time.
- Students are expected to participate in online discussions through the Moodle page

4. Course schedule and structure

This course consists of approximately 55 hours of class contact hours, including lectures, tutorials and labs. You are expected to take an additional 95 hours of non-class time to complete assessments, readings and exam preparation.

Week	Materials Topics	Chemistry Topics
1	Introduction Bonding between atoms	Elementary atomic structure Isotopes Nomenclature The mole concept Atomic and molar mass Stoichiometry Formulae
2	Packing of atoms in solids Young's modulus	Equations Chemical reaction types Precipitation reaction Acid-base reaction Molarity
3	Yield and tensile strength Dislocations Strengthening methods	Redox reaction Oxidation numbers Oxidation state Limiting reactants and product yields Ionic, covalent and metallic bonding Electronic configuration
4	Fracture Toughness Micromechanisms of fast fracture Fatigue mechanisms	Electronegativity Bond polarity and strength Molecular shape Lewis structure
5	Creep Creep fracture and mechanisms Creep resistance Oxidation	Solids, liquids and gases Intermolecular forces Melting and boiling points Solvent and solubility
6	No Classes	
7	Mid-term exam Wet corrosion	Types of solids Ceramics and glasses Chemical vapour deposition The equilibrium state Equilibrium constants Le Chatelier's principle Quantitative calculations pH and buffers
8	Phase diagrams Kinetics of structural change	Organic compound Hydrocarbons Nomenclature of hydrocarbons
9	Steels Ceramics and glasses	Common organic functional groups

		Isomer and stereochemistry Organic reactions Oxidation, reduction, addition, substitution, and elimination
10	Polymers Composites	Major types of polymers Properties of polymers Synthesis of polymers Application of polymers

Chemistry Tutorials

General times and locations are shown on your enrolment timetable on MyUNSW. Be aware that the rooms may have been changed in response to changes in student numbers, so download a fresh timetable often from MyUNSW.

The Chemistry tutorial questions and laboratory manual will be available online, however you must have either a printed copy of the experiment with you in the laboratory, or you must have the manual available on a laptop or tablet with you in the laboratory. Phones are not allowed to be used in the laboratory, so viewing the manual on a small device such as a phone is not allowed.

Chemistry Labs

You must READ THE INTRODUCTION IN THE LABORATORY MANUAL to be aware of all the requirements for passing the laboratory component of this course. Here are some of the main points regarding laboratory classes:

Depending on the lab stream you have enrolled in you will carry out your chemistry labs either in odd numbered semester weeks (weeks 1, 3, 5, and 7) or (mostly) even numbered semester weeks (Weeks 2, 4, 8, 9). You will do the experiments in the order they are listed in the laboratory manual (see the schedule on page 4 of the chemistry lab manual).

Before the first lab, complete the pre-lab work for the first experiment. Use the link provided in the ‘CHEMISTRY STRAND - Laboratory’ section on Moodle to log on and complete these tasks. You will need to do a safety pre-lab before each subsequent lab. Before the end of week 2 you must also complete the 'Safety in the Chemistry Laboratory' exercise (page 11) and bring this to your second chemistry laboratory class.

Chemistry lab classes will be held in rooms 133, 162 or 165 (see your timetable to find which lab you are in) in the Chemical Sciences Building (F10). Bring your lab coat and safety glasses (see details below) and wear enclosed footwear. Students must bring their chemistry lab notes with them to each lab class. The lab manual contains details of requirements for submission of lab reports.

Materials Labs

All instructions for the labs will be provided in the Materials Lab Information Booklet available on Moodle. There are four lab activities, and these are scheduled to be run in Week 2-10. All students should wear closed shoes when attending the laboratories. Students should bring their own safety glasses. Since there is a limitation of numbers of students who can attend the lab, online recordings of the lab activities will be prepared and provided for the students who cannot attend.

Students are expected to bring printouts or the online copies of the laboratory assignment booklets when they attend the class so as to take down notes or data related to the lab activity. Materials labs will be held in 113 (Mechanical testing, Composites testing) or G12/G14 (Fracture, Casting & Recrystallisation).

Student should assemble outside the east end of the Hilmer building E10 for their demonstration activity. The demonstrator of the lab will come and collect the students. Please ensure that you arrive at least 5 minutes prior to the lab start time; otherwise you may miss out on the lab activity.

Safety

You need to do a pre-lab safety exercise for each chemistry lab experiment. This must be done online via the link provided in Moodle, any time before your experiment. The answers should be written in the spaces provided in the lab notes of the experiment.

You must provide your own safety eyewear and laboratory coat and wear enclosed footwear in the laboratory. No exceptions can be made. Safety glasses and lab coats suitable for chemistry labs can be purchased from several shops on campus (disposable paper lab coats are not acceptable). The Optometry Clinic (in the Rupert Myers Building; between the hours of 9 am to 5 pm weekdays) also sells safety glasses and provides expert fittings.

For Term 3, 2020 extra requirements to ensure social distancing will be in place. There will be an assembly point outside the Chemical Sciences building – do not enter the building until instructed, and face masks will be required in addition to the protective equipment listed above. Full details are in the chemistry laboratory manual (page 5). There will be no loan equipment (safety glasses, lab coats) and any student who does not bring their own protective equipment will not be admitted.

5. Assessment

5.1 Assessment tasks

Assessment task	Description	Weight	Due date
Mid-term exam:	2 hr exam that will cover the content taught in the first 5 weeks of both strands.	30%	Week 7
Materials laboratory reports:	4 laboratory worksheets that include short answers and numerical questions. All working must be shown. The laboratories cover the following topics: 1) Tensile testing 2) Fracture of materials 3) Casting and recrystallisation 4) Composite mechanical testing A lab quiz is to be completed during the lab weeks.	15%	1 week after the lab
Chemistry laboratory reports:	4 laboratory reports consisting of observations, calculations and short answer questions that are to be completed during class. The report sheets from your lab manual must be submitted to the demonstrator. Assessment is based on students demonstrating competence at specific skills. The laboratories cover the following topics: 1) Determination of the molar mass of an acid by titration 2) The chemistry of corrosion 3) Determination of iron in haematite 4) Synthesis of aspirin	15%	See lab manual
Final exam:	The exam will cover the content taught in weeks 5-10 of both strands.	40%	Final exam period

Further information

UNSW grading system: https://student.unsw.edu.au/grades

UNSW assessment policy: https://student.unsw.edu.au/assessment

5.2 Assessment criteria and standards

Assessment criteria and standards for each assessment tasks are available on the course Moodle page.

5.3 Submission of assessment tasks

- Assignments/lab reports submitted after the due date for submission will receive a 5% of maximum grade penalty for every day late, or part thereof, up to a maximum of 5 days after which the assignment/lab report will not be accepted
- UNSW operates under a Fit to Sit/ Submit rule for all assessments. If a student wishes to submit an application for special consideration for an exam or assessment, the application must be submitted prior to the start of the exam or before an assessment is submitted. If a student sits the exam/ submits an assignment, they are declaring themselves well enough to do so. Information on this process can be found here: https://student.unsw.edu.au/special-consideration. Medical

certificates or other appropriate documents must be included. Students should also advise thelecturer of the situation.

- Unless otherwise specified in the task criteria, all assignments must be uploaded via Moodle prior to the due date for submission.
- Students who have a disability that requires some adjustment in their teaching or learning environment are encouraged to discuss their study needs with the course coordinator prior to, or at the commencement of, their course, or with the Equity Officer (Disability) in the Equity and Diversity Unit: https://student.unsw.edu.au/disability. Early notification is essential to enable any necessary adjustments to be made.
- Rules governing conduct during exams are given at: https://student.unsw.edu.au/exam-rules

5.4. Feedback on assessment

Lab reports: Students will receive their mark and individualised feedback on the areas they excelled at and which areas of the reports that were not answered correctly. Feedback will be provided through Moodle, two weeks after submission.

Midsession exams: Students will receive their marked exams indicating what questions were answered correctly and incorrectly. Overall comments and worked solutions may be provided to the class.

Final exam: Students will receive their final mark.

6. Academic integrity, referencing and plagiarism

Referencing is a way of acknowledging the sources of information that you use to research your assignments. You need to provide a reference whenever you draw on someone else's words, ideas or research. Not referencing other people's work can constitute plagiarism.

Further information about referencing styles can be located at https://student.unsw.edu.au/referencing

Academic integrity is fundamental to success at university. Academic integrity can be defined as a commitment to six fundamental values in academic pursuits**:** honesty, trust, fairness, respect, responsibility and courage.[1] At UNSW, this means that your work must be your own, and others' ideas should be appropriately acknowledged. If you don't follow these rules, plagiarism may be detected in your work.

Further information about academic integrity and **plagiarism** can be located at:

- The *Current Students* site https://student.unsw.edu.au/plagiarism**,** and
- The *ELISE* training site http://subjectguides.library.unsw.edu.au/elise/presenting

The *Conduct and Integrity Unit* provides further resources to assist you to understand your conduct obligations as a student: https://student.unsw.edu.au/conduct.

[1] International Center for Academic Integrity, 'The Fundamental Values of Academic Integrity', T. Fishman (ed), Clemson University, 2013.

7. Readings and resources

- Engineering Materials, Volumes 1 & 2 Ashby & Jones, Butterworth Heinemann, 2005
- Silberberg, 'Chemistry - The Molecular Nature of Matter & Change', McGraw Hill 2nd Edition or higher.

8. Administrative matters

Materials School Office: Room 137, Building E10 School of Materials Science and Engineering
Materials School Website: http://www.materials.unsw.edu.au/
Chemistry Student Centre: Room 105, Dalton Building
Chemistry School Website: http://www.chemistry.unsw.edu.au/current-students
Faculty Office: Robert Webster Building, Room 128
Faculty Website: http://www.science.unsw.edu.au/

9. Additional support for students

- The Current Students Gateway: https://student.unsw.edu.au/
- Academic Skills and Support: https://student.unsw.edu.au/academic-skills
- Student Wellbeing, Health and Safety: https://student.unsw.edu.au/wellbeing
- Disability Support Services: https://student.unsw.edu.au/disability-services
- UNSW IT Service Centre: https://www.it.unsw.edu.au/students/index.html
- Assessment Implementation Procedure: https://www.gs.unsw.edu.au/policy/documents/assessmentimplementationprocedure.pdf
- Special Consideration: https://student.unsw.edu.au/special-consideration